Dispersion-tailored optical fibers for specialty applications: Design and certain fabrication issues

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Abstract: In this presentation we would discuss design and fabrication issues with regard to dispersion tailoring of optical fibers for specialty applications. Various design tools, which could be exploited for such purpose, would be discussed.

1. Introduction

Optical fiber communication witnessed mind-boggling progress in the late 1990s with the emergence of dense wavelength division multiplexed transmission in conjunction with fiber amplifiers. The demand for high speed, long-haul networks gave rise to demand for special fibers such as non-zero dispersion-shifted fibers (NZDSF), dispersion compensating fibers (DCF), fibers for realizing specialized components such as fiber couplers for multiplexing pump and signal wavelengths required in configuring fiber amplifiers, erbium doped fibers for realizing erbium doped fiber amplifiers (EDFA), fibers with enhanced photosensitivity for realizing in-fiber grating-based components, fibers with low sensitivity to nonlinear impairments, and many more applications. There has also been a resurgence of interest amongst researchers to design and fabricate an exotic class of special fibers; fibers in which transmission losses of the material would not be a limiting factor while nonlinearity and dispersion characteristics could be conveniently tailored to achieve certain application-specific fibers, not necessarily for telecommunication alone. Research targeted towards such fiber designs led to the emergence of a new class of fibers, broadly referred to as *microstructured optical fibers* (MOF), which are characterized by wavelength-scale refractive index features across its physical cross-section resulting in *photonic bandgaps* when appropriately designed.

2. Broadband DCF

A dual-core DCF was initially designed and fabricated by us with a high negative *D* within the EDFA band and through dispersion slope compensation, it was eventually made broadband DCF and individual designs compatible to conventional G.652 fibers as well as standard NZDSF's were realized with significantly reduced sensitivity to nonlinear impairments through large mode effective area [1,2].

3. Microstructured optical fibers

Bragg fiber is a 1D-version of MOFs. Realization of one of the initial Bragg fibers was reported in 2000 [3]. Several dispersion-tailored Bragg fibers have been designed by us for specialty applications like dispersion compensation, metro-centric applications, supercontinuum generation, etc. Introducing a slow chirp in an otherwise periodic cladding could be exploited to realize parabolic pulses in the temporal domain, ultra-short pulse transmission with insignificant dispersion broadening for biomedical applications, very large mode effective area fibers, etc [4-7].

4. References

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